

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4277	transformer and capacitor and (band with filter)	US-PGPUB; USPAT	OR	ON	2005/12/28 14:43
L2	3085	transformer and capacitor and (band with pass with filter)	US-PGPUB; USPAT	OR	ON	2005/12/28 14:43
L3	793	2 and chip	US-PGPUB; USPAT	OR	ON	2005/12/28 14:43
L4	579	3 and @ad<"20020222"	US-PGPUB; USPAT	OR	ON	2005/12/28 16:18
L6	82	4 and (transformer with (metal or metallic or alloy or conductor or conductive or conducting))	US-PGPUB; USPAT	OR	ON	2005/12/28 16:13
L7	13	4 and (transformer with (metal or metallic))	US-PGPUB; USPAT	OR	ON	2005/12/28 14:57
L8	3	((("6045893") or ("6014386") or ("5949299")).PN.	US-PGPUB; USPAT	OR	OFF	2005/12/28 14:57
L9	69	6 not 7	US-PGPUB; USPAT	OR	ON	2005/12/28 17:05
L10	69	6 not 7	US-PGPUB; USPAT	OR	ON	2005/12/28 16:09
L11	174	4 and (high adj pass) and (low adj pass)	US-PGPUB; USPAT	OR	ON	2005/12/28 16:14
L12	4	4 and (transformer with (high adj pass)) and (capacitor with (low adj pass))	US-PGPUB; USPAT	OR	ON	2005/12/28 16:17
L13	80	(transformer with (high adj pass)) and (capacitor with (low adj pass))	US-PGPUB; USPAT	OR	ON	2005/12/28 16:29
L14	48	13 and (band with filter)	US-PGPUB; USPAT	OR	ON	2005/12/28 16:30
L15	38	14 and @ad<"20020222"	US-PGPUB; USPAT	OR	ON	2005/12/28 17:07
L16	35	(transformer with (high adj pass)) and (capacitor with (low adj pass))	USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/12/28 16:29
L17	15	16 and (band with filter)	USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/12/28 16:30
L18	0	communication with system with (on adj chip)	US-PGPUB; USPAT	OR	ON	2005/12/28 17:06
L19	5654	communication with system with chip	US-PGPUB; USPAT	OR	ON	2005/12/28 17:06
L20	164	19 and capacitor and transformer	US-PGPUB; USPAT	OR	ON	2005/12/28 17:07

L21	98	20 and @ad<"20020222"	US-PGPUB; USPAT	OR	ON	2005/12/28 17:13
L22	20	21 and (band same pass)	US-PGPUB; USPAT	OR	ON	2005/12/28 17:11
L23	0	(on with chip with transformer with filter)	US-PGPUB; USPAT	OR	ON	2005/12/28 17:12
L24	0	(on with chip) same transformer same filter	US-PGPUB; USPAT	OR	ON	2005/12/28 17:12
L25	151	(chip with transformer) same filter	US-PGPUB; USPAT	OR	ON	2005/12/28 17:13
L26	65	(chip with transformer) same filter same capacitor	US-PGPUB; USPAT	OR	ON	2005/12/28 17:13
L27	40	26 and @ad<"20020222"	US-PGPUB; USPAT	OR	ON	2005/12/28 17:23
L28	0	(badawy adj elsharawy) and @ad<"20020222"	US-PGPUB; USPAT	OR	ON	2005/12/28 17:24
L29	0	(badawy adj elsharawy)	USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/12/28 17:24
L30	2	(badawy with elsharawy)	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2005/12/28 17:24

US-PAT-NO: 6798288

DOCUMENT-IDENTIFIER: US 6798288 B1

**\*\*See image for Certificate of Correction\*\***

TITLE: Receive band rejection for a digital RF amplifier

----- KWIC -----

Abstract Text - ABTX (1):

A bandpass amplifier for use in a communication system is described. The amplifier includes a frequency selective network having a feedback path. The frequency selective network has first filtering circuitry for selectively passing the transmit **band**, and second filtering circuitry for selectively passing the receive **band**. The first filtering circuitry and the second filtering circuitry **pass** frequencies in the transmit **band** and reject frequencies in the receive **band**. A sampling analog-to-digital converter is coupled to the frequency selective network. A switching device is coupled to the sampling analog-to-digital converter for producing a continuous-time output signal. A feedback path is provided for continuously sensing and feeding back the continuous-time output signal to the frequency selective network.

Application Filing Date - AD (1):

**20010925**

Brief Summary Text - BSTX (13):

According to a specific embodiment of the present invention, the bandpass amplifier further includes a signal generator for applying a test signal to a selected one of the resonators; a peak detector for detecting a signal strength of the signal passed through the selected one; and control circuitry for adjusting the selected resonator to maximize signal **pass** rate of the selected resonator at the corresponding one of the transmit and receive **bands**.

Brief Summary Text - BSTX (14):

Another aspect of the present invention provides a method of calibrating a bandpass amplifier having a transmit **band** and a receive **band** associated therewith. The method includes receiving information representing the transmit **band**; calculating the receive **band** based on the information and a frequency offset between the transmit **band** and the receive **band**; and adjusting the first filtering circuitry and the second filtering circuitry to maximize signal **pass**

rate at the transmit band and the receive band, respectively.

Detailed Description Text - DETX (6):

One possible implementation of the output stage 54 includes two transistors T1 and T2, inductors L1, L2, and L3, capacitors C1, C2 and C3, and a pre-driver D. The pre-driver D is configured to buffer signal 58 and to provide signal 58 and its complement to the gates of the transistor T1 and the transistor T2, respectively. The drain of the transistor T1 is coupled to Vcc and the source is coupled to a node A. The capacitor C1 is typically the parasitic capacitor between the source and drain of the transistor T1. The drain of the transistor T2 is coupled to a node B and the source is coupled to ground. The capacitor C2 is typically the parasitic capacitor between the source and drain of the transistor T2. The inductor L1 is coupled between the node A and the node B, and the inductors L2 and L3 are coupled between the capacitor C3 and the nodes A and B, respectively.

Detailed Description Text - DETX (7):

During operation, the digital signal 58 generated by the A/D converter 52 transitions between high and low levels in accordance with the information being transmitted. Since the signal 58 and its complement are provided to the gates of the transistors T1 and T2 respectively, one transistor is on and the other is off depending on the state of the signal 58. When the signal 58 transitions low level for example, T1 turns off and 77 turns on. When this occurs, node A resonates due to the formation of a resonating circuit within the output stage 54. This resonating circuit is formed by C1, the three inductors L1, L2, and L3, and node B which is pulled to ground through T2. Driver circuit 54 thus in effect contains two separate resonators at nodes A and B. Depending on the state of signal 58, one node resonates while the other is clamped. In one embodiment, the resonators are tuned to resonate at the sampling frequency of 3.6 GHz. This is accomplished by selecting the values of inductors L1, L2, and L3 and capacitors C1, C2 and C3. According to a specific embodiment, C3 is selected to bypass an undesired frequency component outputted from the output stage 54.

Detailed Description Text - DETX (8):

The output of the switching stage 54 is provided to the matching network 36 which acts as a bandpass filter operating at the transmit band (e.g., 824-849 MHz). Since the antenna 20 transmits at the 900 MHz band in the above-described embodiment, the "tracking" function of the matching network 36 needs to match this frequency. In one embodiment, this is accomplished by selecting the values of L1, L2, and L3, and C3 so that the resonance circuit has a transfer function looking into matching network 36 of approximately 900

MHz so that the output bit pattern is generated by T1 and T7 has an energy component at the transmit **band**. In other words, the matching network 36 has to provide a signal **pass** rate sufficient to make sure that the bit pattern has sufficient energy at the transmit **band** for the impedance of the antenna 20 (which is typically 50 ohms).

#### Detailed Description Text - DETX (9):

In another embodiment, the matching network 36 uses the bond wires on the chip containing the power amplifier 34 and other passive components, to create a matching network to provide optimal power transfer to the antenna 20 and to transform the impedance of the antenna 20 to an impedance where the desired power level can be achieved from a given supply voltage. This requires a relatively high Q filter that has a relatively narrow band. In yet another embodiment, the power amplifier 34 is designed to have a bridged output. In applications where the antenna 20 has a single ended output, a BALUN (balance-to-unbalance **transformer** or a passive LC combiner may be used.

#### Detailed Description Text - DETX (12):

Referring to FIG. 4, a simplified schematic representation of a specific embodiment of the frequency selective network 50 is shown. The frequency selective network 50 includes a current source 70, a first resonator circuit 72 including an inductor L5 and a **capacitor** C5, and a second resonator circuit 74 including an inductor L6 and a **capacitor** C6. The resonator circuit 72 is designed, by selecting the appropriate values of L5 and C5, to resonate at the transmit band frequency and to short at other frequencies. The resonator circuit 74 is configured to resonate at the receive band frequency, also by selecting the appropriate values of L6 and C6, and to short at other frequencies. Thus, the frequency selective network 50 shapes the signals passing through the network by removing components of the receive band from the transmit band and vice versa. The matching network 36, which is a bandpass filter tuned at the transmit band, prevents any receive band information passing through the output stage 54 from being transmitted by the antenna 20. It should be noted that the circuit of FIG. 4 is only exemplary, and that a wide variety of wave shaping circuits that perform similar functions may be used to implement various embodiments of the invention.

#### Detailed Description Text - DETX (18):

A node 601 receives an RF input signal from, for example, the output of the matching network 32. The frequency selective network 50 enables the RF input signal at the node 601 to **pass** through (i) a first signal path 691 including receive **band** resonators 611-613 and a transmit **band** resonator 615; and (ii) a second signal path 692 including receive **band** resonators 611 and 612 and a

transmit band resonator 616. The transmit band resonators 615 and 616 are operable to resonate at the transmit band, and the receive band resonators 611-613 are operable to resonate at the receive band.

Detailed Description Text - DETX (27):

Each of the transmit band resonators 715-717 and the receive band resonators 711-713 includes a transconductive element  $G_m$  implemented by, for example, an FET (field effect transistor), and a resonant element TX/RX implemented by, for example, an inductive element and a capacitive element. In order to adjust the resonant frequency of the resonator to the desired frequency, the capacitive element may include a bank of capacitors. In order to change the capacitance of the bank of capacitors, a switch may be used to selectively couple a part or all of the capacitors to the rest of the resonator.

Detailed Description Text - DETX (29):

A node 701 receives an RF input signal from, for example, the output of the matching network 32. The frequency selective network 50 enables the RF input signal at the node 701 to pass through (i) the first signal path 791 including receive band resonators 711-713 and the transmit band resonator 715; and (ii) the second signal path 792 including the receive band resonators 711 and 712 and the transmit band resonators 716 and 717. The transmit band resonators 715-717 are operable to resonate at the transmit band, and the receive band resonators 711-713 are operable to resonate at the receive band.

Detailed Description Text - DETX (42):

At 1140, the controller in the mobile phone adjusts each of the transmit and receive band resonators to the transmit and receive band frequencies in order to maximize signal pass rate at the transmit band and the receive band, respectively. According to some embodiments, this adjustment of the transmit and receive band resonators is performed by the controller for each and every resonator one-by-one. However, according to other embodiments, the adjustment of resonators may be done for only a part of the resonators included in the system.

Detailed Description Text - DETX (53):

The relationship of  $S_{c \rightarrow s_p}$  means that the resonant frequency of the receive band resonator 611 is higher than the test signal. At 1350, the controller 1215 causes the register 1219 to increase the capacitance which governs the resonant frequency of the resonator 611 through a data bus 1218. The register 1219 makes or breaks switches 1241-1245 through control lines 1260 based on the data sent from the controller 1215 through the data bus 1218. The switches 1241-1245 changes the total capacitance included in the receive band

resonator 611, which is a sum of capacitors 1251-1255 included in a capacitor bank 1250. The resonant frequency of the resonator 611 is determined by an inductive element 1261, and the capacitors 1251-1255. The resonator 611 also includes a resistive element 1263 and a current source element 1265.

Detailed Description Text - DETX (54):

Suppose the switches 1241-1245 are all open in the initial condition. If  $Sc > Sp$ , i.e., the resonant frequency of the resonator 611 is higher than the test signal generated by the signal generator 1211, then the controller 1215 lowers the resonant frequency by increasing the capacitance of the capacitor bank 1250. Specifically, the controller 1215 causes the switch 1241 to be closed through the register 1219 so that the capacitance of the resonator 611 is increased by the capacitance of the capacitor 1251.

Detailed Description Text - DETX (55):

Then, the controller 1215 stores the current signal strength  $Sc$  as the previous signal strength  $Sp$  for later calculation. The process goes back to 1330. At 1330, the controller 1215 detects the current signal strength  $Sc$ . Suppose at 1340,  $Sc = Sp$  or  $Sc < Sp$ . Then, the process returns to 1310. When the relationship  $Sc > Sp$  is not satisfied, the resonance frequency of the resonator 611 is deemed to be adjusted to the test signal which is the same as that of the receive frequency. Therefore, if the decision at 1340 is No, the calibration of the resonator 611 deemed to be completed. Unless the calibration is completed, the capacitance of the capacitor bank 1250 is increased monotonously by adding capacitors 1252-1254 one by one.

Detailed Description Text - DETX (61):

It should be understood that the controller 1215 may take various forms. It may include one or more general purpose microprocessors that are selectively configured or reconfigured to implement the functions described herein. Or, it may include one or more specially designed processors or microcontrollers that contain logic and/or circuitry for implementing the functions described herein. Any of the logical devices serving as the controller 1215 may be designed as general purpose microprocessors, microcontrollers, application specific integrated circuits (ASICs), digital signal processors (DSPs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), and the like. They may execute instructions under the control of the hardware, firmware, software, reconfigurable hardware, combinations of these, etc. The hardware elements described above may be configured (usually temporarily) to act as one or more software modules for performing the operations of the present invention. All or any part of the bandpass amplifier and the communication system according to the present invention described above may be manufactured

on a semiconductor chip, or may be manufactured as a hybrid integrated circuit.

Claims Text - CLTX (1):

1. A bandpass amplifier for use in a communication system having a transmit band and a receive band associated therewith, comprising: a frequency selective network for noise shaping an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band; an analog-to-digital converter coupled to the frequency selective network; a switching device coupled to the analog-to-digital converter for producing an output signal; and a feedback path for feeding back the output signal to the frequency selective network to facilitate the noise shaping, wherein the first filtering circuitry comprises at least one transmit band resonator operable to resonate at the transmit band, and the second filtering circuitry comprises at least one receive band resonator operable to resonate at the receive band, wherein at least one of the transmit band and receive band resonators comprises a transconductive element, an inductive element, and a capacitive element, and wherein the capacitive element comprises a bank of capacitors for tuning the corresponding resonator.

Claims Text - CLTX (11):

11. The bandpass amplifier of claim 2, further comprising: a signal generator for applying a signal to a selected one of the first number of transmit band resonators, the second number of receive band resonators, the third number of transmit band resonators, and the fourth number of receive band resonators; a peak detector for detecting a signal strength of the signal passed through the selected one; and control circuitry for adjusting the selected resonator to maximize signal pass rate of the selected resonator at the corresponding one of the transmit and receive bands.

Claims Text - CLTX (12):

12. The bandpass amplifier of claim 11, wherein the control circuitry is further operable to receive information representing the transmit band, calculate the receive band based on the information, and adjust the first number of transmit band resonators, the second number of receive band resonators, the third number of transmit band resonators, and the fourth number of receive band resonators to maximize signal pass rate at the corresponding one of the transmit and receive bands.

Claims Text - CLTX (13):



13. A bandpass amplifier for use in a communication system having a transmit band and a receive band associated therewith, comprising: a frequency selective network for noise shaping an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band; an analog-to-digital converter coupled to the frequency selective network; a switching device coupled to the analog-to-digital converter for producing an output signal; a feedback path for feeding back the output signal to the frequency selective network to facilitate the noise shaping; a signal generator for applying a signal to a selected one of the first filtering circuitry, and the second filtering circuitry; a peak detector for detecting a strength of the signal passed through the selected filtering circuitry; and control circuitry for adjusting the selected filtering circuitry to maximize signal pass rate of the selected filtering circuitry at the corresponding one of the transmit and receive bands.

Claims Text - CLTX (14):

14. The bandpass amplifier of claim 13, wherein the control circuitry is further operable to receive information representing the transmit band; calculate the receive band based on the information; and adjust the first filtering circuitry and the second filtering circuitry to maximize signal pass rate at the transmit band and the receive band, respectively.

Claims Text - CLTX (15):

15. A communication system having a bandpass amplifier having a transmit band and a receive band associated therewith, comprising: a frequency selective network for noise shaving an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band; an analog-to-digital converter coupled to the frequency selective network; a switching device coupled to the analog-to-digital converter for producing an output signal; and a feedback path for feeding back the output signal to the frequency selective network to facilitate the noise shaping, wherein the first filtering circuitry comprises at least one transmit band resonator operable to resonate at the transmit band, and the second filtering circuitry comprises at least one receive band resonator operable to resonate at the receive band, wherein at least one of the transmit band and receive band resonators comprises a transconductive element, an inductive element, and a capacitive element, and

wherein the capacitive element comprises a bank of capacitors for tuning the corresponding resonator.

Claims Text - CLTX (17):

17. A communication system having a bandpass amplifier having a transmit band and a receive band associated therewith, comprising: a frequency selective network for noise shaping an input signal, the frequency selective network comprising first filtering circuitry for selectively passing the transmit band, and second filtering circuitry for selectively passing the receive band, the first and second filtering circuitry being configured to effect suppression of energy associated with the transmit band in the receive band; an analog-to-digital converter coupled to the frequency selective network; a switching device coupled to the analog-to-digital converter for producing an output signal; a feedback path for feeding back the output signal to the frequency selective network to facilitate the noise shaping; a signal generator for applying a signal to a selected one of the first filtering circuitry, and the second filtering circuitry; a peak detector for detecting a strength of the signal passed through the selected filtering circuitry; and control circuitry for adjusting the selected filtering circuitry to maximize signal pass rate of the selected filtering circuitry at the corresponding one of the transmit and receive bands.

Claims Text - CLTX (18):

18. The communication system of claim 17, wherein the control circuitry is further operable to receive information representing the transmit band; calculate the receive band based on the information; and adjust the first filtering circuitry and the second filtering circuitry to maximize signal pass rate at the transmit band and the receive band, respectively.

Claims Text - CLTX (23):

23. The communication system of claim 22, wherein the control circuitry is further operable to selectively couple at least one of a plurality of capacitors provided in the selected filter; and wherein a variation in the signal strength is determined by comparing a plurality of signal strengths corresponding to different values of the capacitance.

Claims Text - CLTX (25):

25. A method of calibrating a bandpass amplifier having a transmit band and a receive band associated therewith, the bandpass amplifier including first filtering circuitry for selectively passing the transmit band and second filtering circuitry for selectively passing the receive band, comprising: receiving information representing the transmit band; calculating the receive

**band** based on the information and a frequency offset between the transmit **band** and the receive **band**; and adjusting the first filtering circuitry and the second filtering circuitry to maximize signal **pass** rate at the transmit **band** and the receive **band**, respectively, wherein the adjusting includes selecting a filter which is to be calibrated among the first and second filtering circuitry; applying a signal to the selected filter; detecting signal strength of the signal which **passes** through the selected filter; and tuning the selected filter in response to the signal strength.

Claims Text - CLTX (27):

27. The method of claim 26, wherein the modifying includes selectively coupling at least one of a plurality of **capacitors** provided in the selected filter; and wherein a variation in the signal strength is determined by comparing a plurality of signal strengths corresponding to different values of the capacitance.

US-PAT-NO: 6045893

DOCUMENT-IDENTIFIER: US 6045893 A

TITLE: Multilayered electronic part with minimum silver diffusion

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Brief Summary Text - BSTX (3):

Multilayered electronic parts are small-sized electronic parts widely used in a frequency range from low frequency to microwave, and produced by laminating a plurality of ceramic green sheets having thereon printed electrode patterns and integrally sintering the laminated green sheets. The multilayered electronic part includes a single-functional part such as a multilayered **chip capacitor**, a multilayered inductor and a multilayered **transformer**, and a multifunctional part such as a **band pass filter** (BPF), a **low pass filter** (LPF), a **high pass filter** (HPF), an antenna switch, a coupler, etc.

Detailed Description Text - DETX (34):

On some green sheets, internal electrode patterns as shown in FIG. 3 by hatched figures were screen-printed with a commercially available Ag paste containing ethyl cellulose, butyl carbitol, terpeneol, etc. The thickness of the printed electrode was about 10 .mu.m. The printed green sheets and other green sheets (dummy layers) with no printed electrode thereon were stacked as shown in FIG. 3 and subjected to hot-press bonding at 120.degree. C. under a pressure of 20 MPa to obtain laminated body of 34 layers. The laminated body was cut by a dicer to obtain a **chip** having a width/length of 5.5 mm/4 mm and a stacked height of about 2 mm.

Detailed Description Text - DETX (35):

The **chip** was dewaxed at 600.degree. C. After the completion of the dewaxing, a part of air was replaced by nitrogen gas and the temperature was raised to sinter the **chip** at 920.degree. C. for one hour. During the temperature rise from 600.degree. C. and the subsequent sintering process, the pressure of the non-oxidative atmosphere containing 7 to 8 volume % of oxygen was maintained at about 1.05 atm. Then, the sintered **chip** was allowed to cool to room temperature.

Detailed Description Text - DETX (36):

The cooled **chip** was subjected to a heat treatment, which corresponded to baking external electrodes, at 800.degree. C. for one hour in nitrogen atmosphere containing a small amount of oxygen to produce Sample No. 1. During the heat treatment, the pressure of the non-oxidative atmosphere containing 7 to 8 volume % of oxygen was maintained at about 1.05 atm.

Detailed Description Text - DETX (71):

In view of the above results, the following experiment was further conducted. A powder mixture of  $\text{CaZrO}_3$  and 5 weight % or 10 weight %, based on  $\text{CaZrO}_3$ , of  $\text{Bi}_2\text{O}_3$  was calcined and pulverized. The pulverized powder was mixed with a binder, a plasticizer, ethanol and butanol to prepare a slurry, which was then made into the form of green sheet by using a doctor blade. Internal electrode was printed on the surface of each green sheet using the Ag paste. The printed green sheets were then dried, stacked, press-bonded and cut out to prepare green **chips**. The green **chips** were sintered in air or nitrogen atmosphere at 900.degree. C. for 2 hours to obtain sintered bodies.

Detailed Description Text - DETX (108):

FIG. 29 shows photomicrographic observation of the upper surface of Sample No. 1 of Example 1, the bottom surface of which is shown in FIG. 4. The alphabetical and numerical markers in FIG. 29 indicate the kind and specification of the multilayered electronic part, and the square marker on the upper left hand indicates the position of the external output terminal. FIG. 29 shows that the ceramic body is semitransparent and free from the blackening, and therefore, excellent in visually identifying or distinguishing the markers. Since the markers are covered with the ceramic, the markers are highly resistant to the surrounding environment. For example, the markers are difficult to be corroded by acids. Therefore, the markers are not corroded or plated in error during the plating treatment such as Ni plating and solder plating at the final stage of production. In addition, the ceramic between the markers and the ceramic body surface prevents the makers from false alteration to ensure the reliability thereof. The markers may be trade marks and sketch of circuits. Further, the markers may serve also as the element of circuit. For example, the above square marker may function as a **capacitor** component when electrically connected to a terminal. Similarly, a part of circuit elements may be used as the markers.

US-PAT-NO: 5949299

DOCUMENT-IDENTIFIER: US 5949299 A

TITLE: Multilayered balance-to-unbalance signal transformer

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Abstract Text - ABTX (1):

A multilayered balun transformer in which not only loss can be suppressed but also phase difference or level difference between balanced signal terminals can be suppressed and which become easy to design. In the multilayered balun signal transformer, a coil 4 and a capacitor C1 are formed in a dielectric by a multilayered structure to thereby form a high-pass filter 6. A low-pass filter 9 is formed from another combination of a coil 7 and a capacitor C2. The high-pass filter 6 and the low-pass filter 9 are arranged lengthwise in the direction of multilayer so that the capacitors C1 and C2 are present on extensions of magnetic flux generated in the inside of the coils 4 and 7 respectively.

TITLE - TI (1):

Multilayered balance-to-unbalance signal transformer

Brief Summary Text - BSTX (2):

The present invention relates to a multilayered balun (balance-to-unbalance) signal transformer which is used in a mobile communication apparatus, or the like.

Brief Summary Text - BSTX (3):

A balun (balance-to-unbalance) transformer has a function of converting an unbalanced signal relative to the ground into balanced signals on a pair of lines or converting balanced signals into an unbalanced signal. The balun transformers of this type are used in transmitting circuits and receiving circuits of mobile communication apparatuses such as portable telephones, car telephones, etc.

Brief Summary Text - BSTX (4):

FIG. 5A shows an example of use of such a balun transformer and an example of a transmitting circuit in a portable telephone. A voice modulation signal 30 and an oscillation signal of a voltage-controlled oscillator 31 are mixed

with each other by a mixer 32. The output of the mixer 32 is made to pass through a band-pass filter 33. An unbalanced signal which is the output of the band-pass filter 33 is converted into balanced signals by the balun transformer 34, so that the balanced signals are supplied to a power amplifier 35 which is a balanced signal input-unbalanced signal output type. The reference numeral 36 designates a coupler for detecting the level of a transmission signal; 37, an AGC circuit for controlling the gain of the power amplifier 35 on the basis of the level of the transmission signal detected by the coupler 36; 38, a low-pass filter; and 39, a duplexer for separating the signal into a transmission signal and a receiving signal by frequencies. Such a balun transformer 34 may be provided between the mixer 32 and the band-pass filter 33. If the balun transformer 34 is used to provide balanced signals to be used in the power amplifier 35, there arises an advantage that the level of noise can be reduced compared with the case where an unbalanced signal is used.

#### Brief Summary Text - BSTX (5):

As the aforementioned balun transformer 34, there is heretofore used a configuration as shown in FIG. 5B in which two transformers 40 and 41 are provided between a pair of balanced signal terminals 1a and 1b and an unbalanced signal terminal 2, a configuration as shown in FIG. 5C in which a transformer 42 is provided between a pair of balanced signal terminals 1a and 1b and an unbalanced signal terminal 2 and in which an intermediate tap of a coil 43 between the balanced signal terminals is connected to the ground, or the like. Although the aforementioned balun transformer has been conventionally achieved by a wire-wound type transformer, a configuration in which a balun transformer is formed from a multilayered structure containing an electrical conductor pattern formed between electrically insulating layers to make coils contained in a chip to thereby form a transmission line type transforming circuit has been described, for example, in JP-A-3-153011, etc.

#### Brief Summary Text - BSTX (6):

The aforementioned conventional balun transformer formed from a multilayered structure is excellent both in reduction of size and in mass production. In order to achieve better characteristic in the transmission line type transformer, however, the degree of coupling between coils is necessary to be enhanced. It is very difficult that such high coupling is achieved by a multilayered structure. Better characteristic than that of the wire-wound type balun transformer has been not achieved. That is, in the case of a multilayered structure, a large loss occurs to bring a problem that phase difference or level difference cannot be suppressed when the balanced signal terminal side is used as the output terminal side. Further, when the winding ratio and inductance are to be set in the case where coils constituting the

transformers 40 and 41 shown in FIG. 5B or the transformer 42 shown in FIG. 5C are contained in a multilayered structure, it is difficult to design the winding ratio, inductance value, etc.

Brief Summary Text - BSTX (8):

The present invention is based on the aforementioned problems and has as its object the provision of a multilayered balance-to-unbalance (balun) signal transformer which is advantageous both in reduction of size and in mass production and in which the loss is so small that the phase difference or level difference between-balanced signal terminals can be suppressed to be designed easily.

Brief Summary Text - BSTX (9):

In order to achieve the above object, according to the present invention, a multilayered balun signal transformer comprises a dielectric block having a multilayered structure; a high-pass filter including a first coil and a first capacitor, the first capacitor and first coil being arranged lengthwise in a direction of the layers of the dielectric block so that the capacitor is located on an extension of magnetic flux generated inside of the first coil; and a low pass filter including a second coil and a second capacitor, the second capacitor and second coil being arranged lengthwise in the direction of layers of the dielectric block so that the capacitor is located on an extension of magnetic flux generated inside of the first coil.

Brief Summary Text - BSTX (10):

Further, according to the present invention, a multilayered balun signal transformer as mentioned above further comprises a first balanced signal terminal formed on a side surface of the multilayered structure, to which one end of said first coil and one end of said first capacitor are connected; a first ground terminal formed on a side surface of said multilayered structure, to which the other end of said first coil is connected; an unbalanced signal terminal formed on a side surface of the multilayered structure, to which the other end of said first capacitor and one end of said second coil are connected; a second balanced signal terminal formed on a side surface of said multilayered structure, to which the other end of said second coil and one end of said second capacitor are connected; and a second ground terminal formed on a side surface of said multilayered structure, to which the other end of said second capacitor is connected.

Brief Summary Text - BSTX (11):

Further, according to the present invention, in the multilayered balun signal transformer, the respective capacitors in the high-pass filter and the



low-pass filter are arranged side by side, and the respective coils in the high-pass filter and the low-pass filter are arranged side by side; and the capacitor-forming side surface is used as a mounting surface.

Brief Summary Text - BSTX (12):

According to the present invention, when an unbalanced signal terminal is disposed in the input side and balanced signal terminals are disposed in the output side, a signal to be transmitted advances by 90 degrees in the capacitor of the high-pass filter and lags by 90 degrees in the coil of the low-pass filter. Accordingly, balanced signals having a phase difference of 180 degrees are obtained in the balanced signal terminals in pair. Contrariwise, when balanced signal terminals are disposed in the input side and an unbalanced signal is disposed in the output side, a signal passing through the capacitor of the high-pass filter advances by 90 degrees and a signal passing through the coil of the low-pass filter lags by 90 degrees. Accordingly, an in-phase synthesized signal is obtained between the unbalanced signal terminal and the ground.

Brief Summary Text - BSTX (13):

Furthermore, the capacitor side is used as the mounting surface side. Accordingly, the capacitors are interposed between the coils and mounting patterns of a substrate on which the balun transformer is to be mounted, so as to play the role of a shield. Accordingly, the influence of the mounting pattern on the operation of the transformer can be reduced.

Drawing Description Text - DRTX (2):

FIG. 1A is a perspective view showing an embodiment of a multilayered balun signal transformer according to the present invention;

Drawing Description Text - DRTX (3):

FIG. 1B is a configuration view of the multilayered balun signal transformer;

Drawing Description Text - DRTX (4):

FIG. 1C is a diagram of a circuit equivalent to the multilayered balun signal transformer;

Drawing Description Text - DRTX (5):

FIG. 1D is a sectional view of the multilayered balun signal transformer;

Drawing Description Text - DRTX (6):

FIGS. 2A to 2H are a series of views showing the multilayered structure of

the multilayered balun signal transformer in the embodiment depicted in FIG. 1;

Drawing Description Text - DRTX (11):

FIG. 5A is a block diagram showing a transmitting circuit of a portable telephone as an example of use of the balun transformer; and

Drawing Description Text - DRTX (12):

FIGS. 5B and 5C are circuit diagrams of conventional balun transformers.

Detailed Description Text - DETX (2):

An embodiment of the present invention will be described below with reference to the drawings. FIGS. 1A to 1D and FIG. 2 show an embodiment of a multilayered balance-to-unbalance (balun) signal transformer according to the present invention. FIG. 1A is a perspective view of the multilayered balun signal transformer; FIG. 1B is a configuration view of the multilayered balun signal transformer; FIG. 1C is a diagram of a circuit equivalent to the multilayered balun signal transformer; FIG. 1D is a sectional view of the multilayered balun signal transformer; and FIG. 2 is a series of views showing a multilayered structure of the multilayered balun signal transformer.

Detailed Description Text - DETX (3):

As shown in FIG. 1D, in the multilayered balun signal transformer of this embodiment, an inductor L1 constituted by a coil 4 formed of an electrical conductor pattern of a metal such as silver, nickel, copper, or the like, and a capacitor C1 constituted by capacitor electrodes 5a and 5b formed of an electrical conductor of the same material as described above are formed in a multilayered body 3 of low dielectric constant constituted by a dielectric of ceramics such as alumina, or the like, or of a mixture of glass and ceramics to thereby form a high-pass filter 6. Further, a low-pass filter 9 is formed from another combination of an inductor L2 constituted by a coil 7 formed of the same material as the coil 4 and a capacitor C2 constituted by capacitor electrodes 8a and 8b formed of the same material as the capacitor electrodes 5a and 5b so that the low-pass filter 9 and the high-pass filter 6 are disposed side by side. In this embodiment, the capacitance values of the capacities C1 and C2 and the inductance values of the inductors L1 and L2 are selected to 2 pF and 18 nH respectively equally.

Detailed Description Text - DETX (4):

Not only the capacitor C1 and the coil 4 in the high-pass filter 6 are arranged lengthwise in the direction of the multilayered structure so that the capacitor C1 is present on an extension of magnetic flux generated in the inside of the coil 4 by means of the coil 4, but also the capacitor C2 and the

coil 7 in the low-pass filter 9 are arranged lengthwise in the direction of the multilayered structure in the same manner as described above.

Detailed Description Text - DETX (5):

As shown in FIGS. 1A and 1B, balanced signal terminals 1a and 1b, an unbalanced signal terminal 2, ground terminals 10 and 11 and a dummy terminal 12 are provided on the side surfaces of the multilayered structure 3. The dummy terminal 12 is soldered to a ground pattern, or the like, of a substrate in order to increase the strength of mounting when the multilayered balun signal transformer is mounted onto the substrate by soldering. The dummy terminal 12 is not connected to any constituent element of the high-pass filter 6 and the low-pass filter 9.

Detailed Description Text - DETX (6):

As shown in FIGS. 1B and 1C, one end of the coil 4 constituting the inductor L1 of the high-pass filter 6 and one end of the capacitor C1 of the high-pass filter 6 are connected to the balanced signal terminal 1a on a side surface of the multilayered structure and the other end of the coil 4 in the high-pass filter 6 is connected to the ground terminal 10 on a side surface of the multilayered structure.

Detailed Description Text - DETX (7):

Further, the other end of the capacitor C1 in the high-pass filter 6 and one end of the coil 7 in the low-pass filter 9 are connected to the unbalanced signal terminal 2 provided on a side surface of the multilayered structure 3. Further, the other end of the coil 7 of the low-pass filter 9 and one end of the capacitor C2 of the low-pass filter 6 are connected to the other balanced signal terminal 1b on a side surface of the multilayered structure 3. Further, the other end of the capacitor C2 of the low-pass filter 9 is connected to the ground terminal 11 on a side surface of the multilayered structure 3.

Detailed Description Text - DETX (8):

When the multilayered balun signal transformer of this embodiment is to be produced by a sheet method, coil patterns 4a to 4e and 7a to 7e constituting the coils 4 and 7 respectively and electrical conductor patterns of the capacitor electrodes 5a, 5b, 8a and 8b are formed on dielectric sheets 3a to 3h as shown in FIGS. 2A to 2H. Further, through-holes a are provided in respective end portions a of the coil patterns 4a to 4e and 7a to 7e so that the through-holes a are connected to corresponding end portions b of the coil patterns on an adjacent sheet in the lower side. Further, these sheets are laminated, solderlessly bonded to one another, sintered and then cut or cut and then sintered. Then, the aforementioned terminals 1a, 1b, 2 and 10 to 12 are

provided on side surfaces of each cut chip to thereby produce the multilayered balun signal transformer. As occasion demands, dielectric sheets with no electrical conductor pattern formed thereon or dielectric sheets having only through-holes provided therein are interposed between the respective layers shown in FIGS. 2A to 2H or on the rear surfaces thereof before lamination. Incidentally, the reference numeral 13 in FIG. 2A designates a mark which is provided near one corner of a multilayer chip in order to indicate the direction of the multilayer chip and which is formed by printing of an electrical conductor. The multilayered balun signal transformer according to the present invention can be also produced by a printing method.

Detailed Description Text - DETX (9):

FIGS. 3A and 3B are graphs showing return loss (loss due to reflection caused by impedance mismatching) and insertion loss in a range of from 850 MHz to 950 MHz in comparison between the case where the prior art 1 as shown in FIG. 5B is achieved by a multilayered balun signal transformer having a size of 3.2 mm.times.2.5 mm.times.1.5 mm, and the case where the multilayered balun signal transformer of the present invention is achieved by the multilayered structure. As is obvious from these graphs, the return loss in the case according to the present invention is reduced compared with the prior art 1 and the insertion loss in the case according to the present invention is also greatly reduced to a value of about 0.2 to 0.3 dB compared with 0.7 to 0.8 dB in the prior art 1 (which is the same as the prior art 2 as shown in FIG. 5C).

Detailed Description Text - DETX (11):

Further, because the multilayered balun signal transformer according to the present invention is formed by using concentrated constant circuits of LC and because the high-pass filter and the low-pass filter are arranged side by side so as not to interfere with each other, characteristic as designed can be obtained easily. Accordingly, it is easy to design the multilayered balun signal transformer. Furthermore, because the design is easy, the frequency range and impedance can be changed easily.

Detailed Description Text - DETX (12):

Further, in the case where the high-pass filter and the low-pass filter are to be arranged side by side, the capacitor C2 may be arranged side by side with the coil 4 of the high-pass filter 6 and the capacitor C1 may be arranged side by side with the coil 7 of the low-pass filter 9. When the capacitors C1 and C2 of the filters 6 and 9 are arranged side by side so as to be used-as the mounting surface as shown in the aforementioned embodiment, the capacitors are interposed between a pattern on the mounting surface of a substrate and the coils 4 and 7 so that the influence of the pattern of the mounting surface on

the operation of the transformer can be reduced.

Detailed Description Text - DETX (13):

According to the present invention, the respective coils and capacitors of the high-pass filter and the low-pass filter are arranged lengthwise side by side in the direction of multilayered structure. Accordingly, the degree of magnetic flux which is generated in the coil of one filter so as to pass through the other filter is reduced so that the interference between the filters is reduced. Accordingly, characteristic of L (inductor) and C (capacitor) is used effectively as it is, so that designing becomes easy. Further, because there is reduced interference between the filters, a multilayered balun signal transformer with low insertion loss, with narrow tolerance of small phase difference and with small level difference between two balanced signal terminals can be provided.

Detailed Description Text - DETX (14):

Furthermore, the capacitors of the filters are arranged side by side so that the capacitor-forming surface is provided as a mounting surface. Accordingly, the influence of the mounting pattern of a substrate for mounting the balun transformer on the operation of the balun transformer can be reduced.

Claims Text - CLTX (1):

1. A multilayered balun signal transformer comprising:

Claims Text - CLTX (3):

a high-pass filter including a first coil and a first capacitor, said first capacitor and first coil being arranged lengthwise in a direction of multilayer of the dielectric block so that said capacitor is located on an extension of magnetic flux generated inside of said first coil; and

Claims Text - CLTX (4):

a low-pass filter and including a second coil and a second capacitor, said second capacitor and second coil being arranged lengthwise in the direction of multilayer of the dielectric block so that said capacitor is located on an extension of magnetic flux generated inside of said first coil;

Claims Text - CLTX (5):

a first balanced signal terminal formed on a side surface of the multilayered structure, to which one end of said first coil and one end of said first capacitor are connected;

Claims Text - CLTX (7):

an unbalanced signal terminal formed on a side surface of said multilayered structure, to which the other end of said first capacitor and one end of said second coil are connected;

Claims Text - CLTX (8):

a second balanced signal terminal formed on a side surface of said multilayered structure, to which the other end of said second coil and one end of said second capacitor are connected; and

Claims Text - CLTX (9):

a second ground terminal formed on a side surface of said multilayered structure, to which the other end of said second capacitor is connected.

Claims Text - CLTX (10):

2. A multilayered balun signal transformer as claimed in claim 1, wherein said first and second capacitors in said high-pass filter and said low-pass filter are respectively arranged side by side and, said first and second coils in said high-pass filter and said low-pass filter are also respectively arranged side by side; and

Claims Text - CLTX (11):

a surface of a capacitor-forming side is used as a mounting surface.

US-PAT-NO: 6731750

DOCUMENT-IDENTIFIER: US 6731750 B1

TITLE: xDSL multiple-point interface device

----- KWIC -----

Brief Summary Text - BSTX (10):

Another preferred embodiment of the present invention enables both low-**band** and high-**band filters**, networks or other signal transform devices to be selectively coupled in the telephone line responsive to conditions existing in the customer system or on the subscriber line. In one such enhanced MPID or signal coupling device a filter may be placed in the circuit upon activation of the hook switch in a connected customer device. In another such enhanced MPID or signal coupling device a filter may be alternatively connected into a circuit feeding a customer device or bypassed in response to loading changes sensed on the subscriber line.

Detailed Description Text - DETX (6):

Continuing with FIG. 1, telephone sets 12(a) . . . (n) are respectively connected through standard silver satin cables 18(a) . . . (n) to MPID section type 20(a) . . . (n) which is, in turn, connected to the telephone line 28 consisting, for example, of twisted pair cable. The telephone line 28 connects to the telephone company local central office in order to establish voice **band** communications in the frequency range of 0 Hz to 4 kHz, although the spectrum is typically further reduced to the range of 200 Hz to 3.4 kHz by electronic codec **filters** in the central office switching system. In addition to passing voice band frequencies, DC signaling and ringing signals are also passed by the MPID section type 20(a) . . . (n). As will be described hereinafter, typical frequency system allocations of the telephone line for the voice band and for xDSL are shown in FIG. 5.

Detailed Description Text - DETX (13):

Referring now to FIG. 4, an exemplary circuit of the MPID type 22 of FIG. 1 and the xDSL modem spectrum section of MPID type 120(a) . . . (n) of FIG. 2 is shown. The function of circuit 300 of FIG. 4 is to provide a high pass **filter** for the xDSL frequency **band** while removing the direct current and providing protection from ring signaling for the attached xDSL modem. Further, the circuit 300 provides a maintenance signature to enable the telephone company

central office to determine whether or not a xDSL modem is attached to the line.

Detailed Description Text - DETX (14):

The maintenance signature of circuit 300 is formed by capacitor 310, diac or dual zener diode 312 and resistor 314. The maintenance signature produced by these components is unique and is specifically designed for xDSL modems.

**Transformer** windings 302(a), 302(b) and 302(c), and capacitors 304, 306 and 308 provide **high pass** filtering, direct current blocking, and reduce ring signaling current so that it is not damaging to the attached xDSL modem.

Detailed Description Text - DETX (17):

FIG. 6 shows a detailed component diagram of an enhanced version of the xDSL Multiple-Point Interface Device section of FIG. 3 enabling the low-pass filter of FIG. 2, or alternatively, a bandpass or a high-pass filter or other signal transform device, to be selectively inserted in or removed from the telephone line as the associated telephone is taken off-hook or placed on-hook respectively. In the illustrative example which follows, a low-pass filter is described as being inserted or removed. However, persons skilled in the art will recognize that other networks or signal transform devices are equally amenable for alternate or selective connection into or out of (i.e., bypassing) the telephone line circuits such as those described herein. In the automatic MPID 500 of FIG. 6, the **low pass** filter of FIG. 3 includes inductors 506, 508, 510 and 512, **capacitors** 514 and 516 and resistors 518 and 520. The terminals of the filter of FIG. 3 are connected respectively to the normally open contacts of relay 502, with the input for the T line connected to contact set 504(a), the input from the R line fed to contact set 504(b), the output to the T.sub.1 line connected to contact set 504(c), and the output to the R.sub.1 line connected to set 504(d). Contact sets 504(a) and 504(b) together form an input switching network. Similarly, contact sets 504(c) and 504(d) form an output switching network. The normally closed contacts of contact sets 504(a) and 504(c) provide a pass-through or bypass conductive path for line T-T.sub.1. The normally closed contact sets 504(b) and 504(d) provide a pass-through or bypass conductive path for line R-R.sub.1. Lines T and R are coupled respectively to the wipers of contact sets 504(a) and 504(b). Similarly, the wipers of contact sets 504(c) and 504(d) are respectively coupled to lines T.sub.1 and R.sub.1. In series with the R line and the wiper of contact set 504(b) is resistor 522 for sensing loop current to provide an off-hook/on-hook indication. The pass through condition exists when the telephone set connected to lines T.sub.1 and R.sub.1 is on-hook and relay 502 is released.